

## § 2. Corrosion Behavior of AlN as a MHD Coating Material for Self-Cooled Li/V Blanket

Suzuki, A., Muroga, T.,  
Yoneoka, T., Tanaka, S. (Quantum Eng. and Systems  
Sci., Univ. of Tokyo)  
Pint, B.A. (Metals and Ceramics Div., Oak Ridge  
National Laboratory)

A self-cooled liquid lithium blanket with vanadium alloy for structural materials is one of the most attractive concepts among blanket concepts for a DEMO fusion reactor of high power density and less radioactive wastes. The primary issue associated with this blanket concept is potentially high magnetohydrodynamics (MHD) pressure drop induced by the liquid lithium flowing through high magnetic fields. In order to reduce the pressure drop to acceptable levels, fabrication of thin insulating coating (MHD coating) on inside surface of tubing has been proposed. The chemical compatibility of the insulating material with liquid Li is considered to be an important first step for developing the insulating coating. Candidate oxide materials for the MHD coating are strictly limited to a small number of less experienced oxides, because  $\text{Li}_2\text{O}$ , which is considered to be an ideal corrosion product, has higher chemical stability than most of the other oxide materials. On the other hand, some nitrides, which are more stable than  $\text{Li}_3\text{N}$ , are considered to potentially withstand the corrosive environments of liquid Li. In particular, aluminum nitride (AlN) is considered to be one of the most promising candidate nitrides because of its high insulating ability and relatively well-developed coating techniques. In this report, we performed experiments on compatibility of AlN bulk specimens with liquid Li up to 1073 K, focusing on effects of oxygen impurity in AlN, nitrogen concentration in liquid Li, and existence of vanadium alloy (V alloy) in contact with the Li, to investigate the corrosion mechanisms in the experiment and in a Li/AlN/V-alloy blanket system.

Two types of high purity AlN bulk samples with different oxygen impurity, Shapal SH-50 with 0.9 wt%-O and Shapal SH-04 with 0.2 wt%-O supplied from Tokuyama Corp., were utilized for experiment. SH-50 and SH-04 (10 mm in diameter with 1.5 mm in thickness) were immersed in 5 - 20 cc of liquid Li charged in capsules or crucibles to perform the sintering test at 723 - 1073 K for 1000 h. In some experiments, V alloy were immersed in the same lithium, in which the AlN samples were fixed by Mo wire. Thus, AlN and V alloy did not contact each other directly; they are in contact with the same Li. The changes on mass of the AlN samples before and after the sintering tests were measured.

Fig. 1 shows mass decrease of the SH-04 specimens after sintering in Li in contact and not in contact with V alloy for 1000h. A uniform mass loss of  $-5 \text{ mg/cm}^2$  corresponds to a decrease of  $15 \mu\text{m}$  in thickness. In the Figure, the specimens corroded by the Li not in contact with V alloy did not decreased its weight up to 1073 K, while the specimens corroded by the Li in contact with V alloy reduced its weight significantly over 973 K. Liquid Li in contact with V alloy,

which absorb nitrogen from the Li at high temperatures, may keep the nitrogen concentration in the Li very low. The liquid Li, in which the nitrogen was continuously absorbed by V alloy, is considered to corrode the AlN continuously resulting in a large decrease of the mass. This implies that reduction of AlN by V alloy through liquid Li may be another process of the degradation in the Li/AlN/V-alloy system.

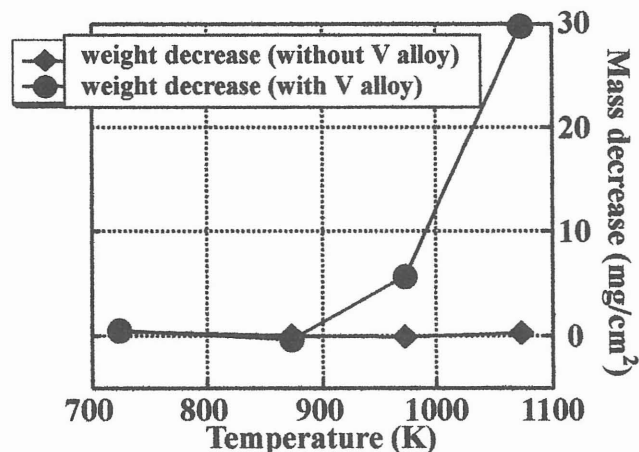


Fig.1 Mass decrease of the SH-04 specimens after sintering in Li in contact and not in contact with V alloy.

Fig. 2 shows mass decrease of the SH-04 and SH-50 specimens after sintering in Li without V alloy for 1000h. Below 873 K, the mass changes were small for both samples. However, the SH-50 decreased its weight over 973 K, while SH-04 samples keep a small mass change. The difference of the weight decrease is considered to be due to that the oxygen impurity, which dissolve into Li to reduce the weight of AlN samples, increase its mobility to react with Li as the temperature increase over 973 K. Thus, reduction of oxygen impurity is considered to result in the decrease of resistivity even at low temperature as well as nitrogen dissolution at higher temperatures.

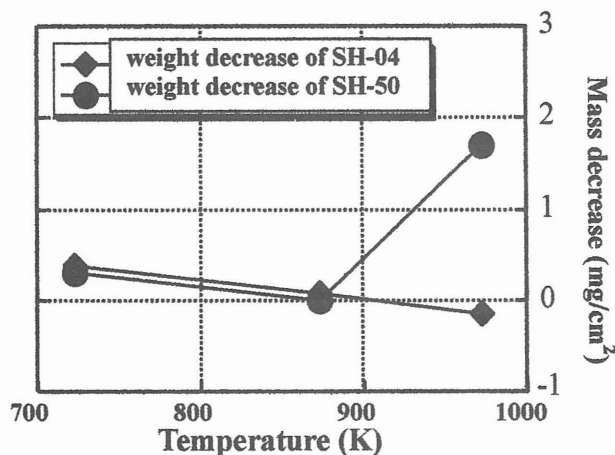


Fig.2 mass decrease of the SH-04 and SH-50 specimens.